Heavy δ^{30}Si in Archean granitoïds as evidence for supracrustal components in their sources

LUC ANDRÉ[1], KATHRIN ABRAHAM[2], STEPHEN F. FOLEY[3], AND AXEL HOFMANN[4]

[1] Earth Sciences Department, Royal Museum for Central Africa, Leuvensesteenweg 13, Tervuren, Belgium.
[2] University of Oxford, Department of Earth Sciences, Oxford, United Kingdom
[3]Dept. Earth and Planetary Sciences, Macquarie University, North Ryde 2109, Australia.
[4] Department of Geology, University of Johannesburg, South Africa.

We report δ^{30}Si data from 37 samples of 17 Archaean (3.5-2.7Ga) felsic intrusive rocks from the Kaapvaal craton. They are representative of three types of plutons: (a) Trondhjemite-Tonalite-Granodiorite (TTG) (n=13); (b) Granite-Monzogranite-syenogranite (GMS) (n=15); (c) composite TTG-GMS (n=9). Two to 4 aliquots of each specimen powder were prepared to control the full chemical reproducibility. Each aliquot solution was then analysed 7 to 12 times on two MC-ICP-MS instruments (Nu Plasma II and Thermo Neptune) with an average reproducibility ($2\sigma_M$) of 0.05‰. In terms of their average δ^{30}Si, we find no resolvable isotopic differences between TTGs, TTG-GMSs and GSMs [δ^{30}Si= –0.01±0.07‰ ($\pm2\sigma_X$), –0.02±0.09‰, –0.02±0.13‰, respectively], but they all contrast significantly with coevally run data for the GA granite standard (δ^{30}Si=–0.22±0.08‰). The grand average for these Archaean plutons (δ^{30}Si= –0.02±0.02‰, $\pm2\sigma_M$ for n=37) is significantly heavier than Phanerozoic I- and A-type granites (δ^{30}Si=–0.19±0.02‰, $\pm2\sigma_M$ for n=27 [1,2]), and rhyolitic liquids differentiated from basalts (δ^{30}Si=–0.19±0.02‰ [3]). We do not see any significant δ^{30}Si trends with pluton age and SiO_2 contents, nor with the large variations in La_N/Yb_N (5 to 68) and Sr/Y (0.25 to 250). Therefore, melting or crystallisation in the garnet or plagioclase stability fields can be ruled out as a cause for this heavy signature, the origin of which must be rooted in the source protoliths. Our preferred explanation is the melting of recycled silicified basalts (δ^{30}Si: +0.49±0.54‰ [4]) and cherts (δ^{30}Si: +0.60±0.44‰ [4]) which are common supracrustal rocks during the Eo- and Paleo- Archean Era.

[1] Savage et al. (2012) GCA 92, 184-202. [2] Poitrasson & Zambardi (2015) GCA 167 , 301-312. [3] Savage et al. (2011) GCA 75, 6124-6139 [4] Abraham et al. (2011) EPSL 301, 222-230.